CLAIMS

1. An electrolytic processing apparatus comprising:

at least one processing electrode;

at least one feeding electrode disposed on the same side as said at least one processing electrode with respect to a workpiece;

a workpiece holder for holding the workpiece and bringing the workpiece into contact with or close to said at least one processing electrode;

a power supply for applying a voltage between said at least one processing electrode and said at least one feeding electrode; and

a fluid supply unit for supplying a fluid between the workpiece and said at least one processing electrode,

wherein at least one of said at least one processing electrode and said at least one feeding electrode comprises:

a conductive material; and

an organic compound having an ion exchange group, said organic compound being chemically bonded to a surface of said conductive material to form an ion exchange material on the surface of said conductive material.

2. The electrolytic processing apparatus according to claim 1, wherein said organic compound comprises an organic compound selected from the group consisting of thiol and disulfide.

3. The electrolytic processing apparatus according to claim 1, wherein said ion exchange group comprises at least one of ion exchange groups selected from the group consisting of a sulfonic acid group, a carboxyl group, a quaternary ammonium group, and an amino group.

4. The electrolytic processing apparatus according to claim 1, wherein said conductive material includes at least one of gold, silver, platinum, copper, gallium arsenide, cadmium sulfide, and indium oxide (III).

5. The electrolytic processing apparatus according to claim 1, wherein said at least one processing electrode and said at least one feeding electrode are disposed in a spaced relationship, and

wherein each of said at least one processing electrode and said at least one feeding electrode comprises:

a conductive material; and

an organic compound having an ion exchange group, said organic compound being chemically bonded to a surface of said conductive material to form an ion exchange material on the surface of said conductive material.

6. An electrolytic processing apparatus comprising:

at least one processing electrode;

at least one feeding electrode disposed on the same side as said at least one processing electrode with respect to a workpiece;

a workpiece holder for holding the workpiece and bringing the workpiece into contact with or close to said at least one processing electrode;

a power supply for applying a voltage between said at least one processing electrode and said at least one feeding electrode; and

a fluid supply unit for supplying a fluid between the workpiece and said at least one processing electrode,

wherein at least one of said at least one processing electrode and said at least one feeding electrode comprises:

a conductive carbon material; and

an ionic dissociation functional group chemically modifying a surface of said conductive carbon material.

7. The electrolytic processing apparatus according to claim 6, wherein said ionic dissociation functional group comprises a carboxyl group.

8. The electrolytic processing apparatus according to claim 6, wherein said ionic dissociation functional group comprises at least one of ion exchange groups selected from the group consisting of a quaternary ammonium group, and a tertiary or lower amino group.

9. The electrolytic processing apparatus according to claim 6, wherein said conductive carbon material comprises a conductive carbon material selected from the group consisting of glassy carbon, fullerene, and carbon nanotubes.

10. An electrolytic processing apparatus comprising:

at least one processing electrode;

at least one feeding electrode disposed on the same side as said at least one processing electrode with respect to a workpiece;

a workpiece holder for holding the workpiece and bringing the workpiece into contact with or close to said at least one processing electrode;

a power supply for applying a voltage between said at least one processing electrode and said at least one feeding electrode; and

a fluid supply unit for supplying a fluid between the workpiece and said at least one processing electrode,

wherein at least one of said at least one processing electrode and said at least one feeding electrode comprises a graphite intercalation compound containing alkali metal.

11. The electrolytic processing apparatus according to any one of claims 1 through 10, wherein the fluid comprises one of pure water, ultrapure water, a liquid having an electric conductivity of 500 μS/cm or less, and an electrolytic solution having an electric conductivity of 500 μS/cm or less.

12. The electrolytic processing apparatus according to any one of claims 1 through 10, further comprising a driving mechanism operable to move the workpiece and at least one of said at least one processing electrode and said at least one feeding electrode relative to each other to provide a relative movement between the workpiece and said at least one of said at least one processing electrode and said at least one feeding electrode.

13. The electrolytic processing apparatus according to claim 12, wherein the relative movement comprises at least one of a rotational movement, a reciprocating movement, an eccentric rotational movement, and a scroll movement.

14. The electrolytic processing apparatus according to claim 13, wherein the relative movement comprises a movement along a surface of the workpiece.

15. The electrolytic processing apparatus according to any one of claims 1 through 10, further comprising an electrode unit having said at least one processing electrode, said at least one feeding electrode, and said fluid supply unit.

16. The electrolytic processing apparatus according to any one of claims 1 through 10, wherein said at least one processing electrode comprises a plurality of processing electrodes,

wherein said at least one feeding electrode comprises a plurality of feeding electrodes, and

wherein said plurality of processing electrodes and said plurality of feeding electrodes are alternately disposed on the same side of the workpiece.

17. The electrolytic processing apparatus according to any one of claims 1 through 10, wherein one of said at least one processing electrode and said at least one feeding electrode is disposed so as to surround the other of said at least one processing electrode and said at least one feeding electrode.

18. The electrolytic processing apparatus according to any one of claims 1 through 10, wherein said at least one feeding electrode comprises a plurality of feeding electrodes provided at a peripheral portion of said at least one processing electrode.

19. The electrolytic processing apparatus according to any one of claims 1 through 10, wherein said at least one processing electrode comprises a plurality of processing electrodes disposed in parallel with each other at equal intervals.

20. A substrate processing apparatus, comprising:

a loading and unloading section for loading and unloading a substrate;

said electrolytic processing apparatus according to any one of claims 1 through 19;

a cleaning device for cleaning the substrate; and

a transfer device for transferring the substrate between said loading and unloading section, said electrolytic processing apparatus, and said cleaning device.

21. The substrate processing apparatus according to claim 20, further comprising a CMP apparatus for chemical mechanical polishing a surface of the substrate.